Photonic crystal fibers infiltrated with metallic nanoparticles dispersed in polydimethylsiloxane

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An experimental results on birefringent photonic crystal fiber (PCF) selectively infiltrated with metallic nanoparticles (NPs) dispersed in polydimethylsiloxane (PDMS) are presented.

In general, PCFs are structures consisting of periodic matrix of microholes surrounding core region, that can be either solid or hollow. The PCSs structure can be infiltrated with different materials that may modify guiding properties of the PCF. Among many materials, liquid crystals (LCs) are most suitable for infiltrating PCF structures mainly due to their high susceptibility on external electric field, that can be additionally enhanced by doping with metallic NPs [1]. Recently a new research line has been initiated by infiltrating PCF structure with PDMS doped with NPs [2]. PDMS is a silicon-based organic material characterized with good optical transparency in the visible region as well as thermal tuning of the refractive index. In our studies we use silver and gold NPs which possesses a localized surface plasmonic resonances in the visible region that depend on the refractive index of the surrounding medium, in this case, PDMS. By infiltrating the PCF structure with this material, it is possible to modify the birefringence of the structure using temperature that may lead to designing tunable filters or attenuators.

As it was numerically demonstrated [2], for polarization maintaining PCF with two large microholes infiltrated with silver NPs dispersed in PDMS, two different attenuations for both polarization of fundamental mode can be observed, and as a result one polarization can be filtered out from the PCF.

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